Evaluate Bull Trout Movements in the Tucannon and Lower Snake Rivers

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Evaluate Bull Trout Movements in the Tucannon and Lower Snake Rivers

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Annual Report - 2003
(December 1, 2002 - December 31, 2003)

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Abstract

We collected 279 adult bull trout (*Salvelinus confluentus*) in the Tucannon River during the Spring and Fall of 2003. Passive Integrated Transponder (PIT) tags were inserted in 191 of them, and we detected existing PIT tags in an additional 31bull trout. Thirty five of these were also surgically implanted with radio-tags, and we monitored the movements of these fish throughout the year. Fourteen radio-tags were recovered shortly after tagging, and as a result, 21 remained in the river through December 31, 2003.

Four bull trout that were radio-tagged in spring 2002 were known to survive and carry their tags through the spring and/or summer of 2003. One of these fish spent the winter near river mile (RM) 13.0; the other 3 over-wintered in the vicinity of the Tucannon Hatchery between RM 34 and 36. Twenty-one radio tags from bull trout tagged in 2002 were recovered during the spring and summer, 2003. These tags became stationary the winter of 2002/2003, and were recovered between RM 11 and 55. We were unable to recover the remaining 15 tags from 2002.

During the month of July, radio-tagged bull trout exhibited a general upstream movement into the upper reaches of the Tucannon subbasin. We observed some downstream movements of radio-tagged bull trout in mid to late September and throughout October. By late November and early December, radio tagged bull trout were relatively stationary, and were distributed from the headwaters downstream to river mile 6.4, near Lower Monumental Pool. As in 2002, we did not conduct work associated with objectives 2, 3, or 4 of this study, because we were unable to monitor migratory movement of radio-tagged bull trout into the Federal hydropower system on the mainstem Snake River.

Transmission tests of submerged ATS model F1830 radio-tags in Lower Granite Pool showed that audible detection and individual tag identification was possible at depths of 20 and 30 ft. Tests were conducted using an ATS R-4000 Receiver equipped with an “H” antenna at 200 and 700 feet above water surface from a helicopter. Audible detection and frequency separation were possible at both elevations.

Two years of high tag loss, particularly after spawning, has prevented us from documenting fall and winter movements with an adequate sample of radio tagged bull trout. The high transmitter loss after spawning may be a reflection of high natural mortality for large, older age fish that we have been radio tagging to accommodate the longer life transmitters. Therefore, we are planning to reduce the size of the radio tags that we implant, and delay most of our collection and tagging of bull trout until after spawning. These changes are a new approach to try to maximize the number of radio tagged bull trout available post spawning to adequately document fall and winter movements and any use of the Snake River by bull trout from the Tucannon River.

Acknowledgements

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Introduction

The ESA (Threatened) listing of the Columbia River Distinct Population Segment of bull trout identified one of the major threats to the species as fragmentation resulting from dams on over wintering habitats of migratory subpopulations (Federal Register, 1998). At the time of listing, it appeared that a migratory subgroup in the Tucannon River may have utilized the mainstem Snake River for adult rearing on a seasonal basis (Underwood et al., 1995). The occurrence of bull trout in the hydropower system had been verified by a few incidental observations during sampling in Lower Monumental Pool (Buchanan et al. 1997 citing Ward), and in the adult passage facilities at Lower Monumental and Little Goose dams in the early 1990s (Kleist, in litt. 1993). Prior to 2001, documentation of fish movement past the adult fish counting windows at Lower Monumental Dam and Little Goose Dam occurred during spring, summer, and fall, but was suspended during winter months (November through March). The FCRPS Biological Opinion (USFWS 2000) required the U. S. Army Corps of Engineers (USACE) to provide data detailing the movement of bull trout past the adult fish counting stations at Lower Monumental and Little Goose Dams. This requirement prompted USACE to extend the collection of adult fish passage data into the winter months (i.e., November through March).

Under contract, the Washington Department of Fish and Wildlife (WDFW) operated time-lapse video equipment to record daily fish passage for ten hours a day (0600 to 1600 hours, PST) during November and December and eight hours a day (0800 to 1600 hours, PST) during January, February, and March. The COE performs annual maintenance on the adult fishways during January and February and the fish ladders are commonly dewatered for a portion of these months. Technicians viewed the time-lapse video footage to document the passage of the standard target fish groups, as well as bull trout.

Time-lapse video counting has not documented the presence of bull trout at Lower Monumental and Little Goose dams, however, bull trout have been observed at the fish viewing windows during other seasons (Richards, pers. comm., 2004). It remains unconfirmed if bull trout from the Tucannon River utilize the main stem Snake River for rearing and foraging as indicated in other Columbia Basin subpopulations (Elle 1995; Faler and Bair 1992; Kelly Ringell and DeLaVergne 2000 and 2001; Schriever and Schiff; 2003; Theisfeld et al. 1996; Underwood et al. 1995). If bull trout originating from the Tucannon River migrate into the mainstem Snake River, it is also unknown if they attempt to pass the existing hydro facilities on a regular basis, or if the fishways are suitable for bull trout passage.

The potential for bull trout movements throughout the migratory corridor is high, but from the standpoint of future delisting and requirements set forth in the FCRPS Biological Opinion (USFWS 2000), the determination of temporal and spatial distribution in the mainstem is crucial in developing recovery actions, estimating “take”, and successful consultation on system improvement actions. This project was designed to help meet Reasonable and Prudent Measures, and Conservation Recommendations

associated with the Lower Snake River dams in the FCRPS Biological Opinion, and to increase understanding of bull trout movements within the Tucannon River drainage.

Rieman and McIntyre (1993) describe unimpeded migratory corridors as important habitats to the persistence and interaction of local populations. They also indicate that disruption and/or modification of migratory corridors can increase stress, reduce growth and survival, and potentially result in the loss of migratory life-history types in a subpopulation. With these factors in mind, the primary question to be answered is: Does the existing hydropower system on the Lower Snake River limit the capabilities of Tucannon River bull trout to complete their migratory behavior, or are the current hydropower operations compatible with recovery and conservation of the species? The secondary goal of the project is to examine the movements and spatial/temporal distribution of migratory bull trout within the Tucannon River and to determine the proportion of migratory fish that leave the Tucannon River to overwinter. The bull trout stock status in the Tucannon River is considered healthy by the Washington Department of Fish and Wildlife (WDFW 1998), but little is known about their migrations in the Tucannon and Snake river subbasins. Martin et al. (1992) and Underwood et al. (1995) studied the interactions of bull trout, steelhead, and Chinook salmon in the Tucannon River during the early 1990's. As part of this larger study, 16 bull trout were radio-tagged and tracked from July through November 1992. The authors indicated that 2 fish may have entered the mainstem Snake River by the last week of October, but they were unable to verify these movements (Underwood et al. 1995).

The objectives of this study are to:

1. Determine the spatial distribution, migration timing, and movements of adult migratory bull trout in the Tucannon and Snake rivers.

2. Determine bull trout use and passage efficiency in fishways at Lower Snake River dams.

3. Estimate frequency of bull trout fall back at Lower Snake River dams.

4. Determine if bull trout losses result from movements out of Lower Monumental Pool.

The primary assumption associated with the study is that the movements of radio-tagged bull trout are not different from the movements of other bull trout in the subgroup. This assumption is critical to the project as a whole. The use of long-life transmitters and tagging well before spawning or major migrations should reduce the effects of tagging on fish behavior. Martin et al. (1995) found that surgically implanted dummy transmitters did not affect fish survival, growth, or gonad development in rainbow trout held in captivity. Radio transmitters have been used in other bull trout studies in recent years with good success (Elle 1995, Faler and Bair 1992, Kelly Ringel and DeLaVergne 2000/2001, Schriever and Schiff 2003, Underwood et al. 1995). Objectives 1, 2 and 4 have critical assumptions, in part, associated with each of those objectives. In order to

determine distribution in the Snake River (Objective 1) and passage efficiency (Objective 2), we must assume that a portion of our group of radio-tagged bull trout will enter the Snake River and at least attempt to pass through a fish ladder in the Lower Snake River. Likewise, in order to estimate the extent of losses in Objective 4, there must be some movement (upstream or downstream) of radio-tagged bull trout out of Lower Monumental Pool and we also assume that radio transmission will be adequate to track bull trout movements throughout the reservoirs.

Study Area

The Tucannon subbasin encompasses the entire Tucannon watershed and all tributaries (approximately 502 square miles). The stream system originates in the Wenaha-Tucannon Wilderness Area, in the northeast portion of the Blue Mountains at an elevation of 6,234 feet (at Diamond Peak) and terminates at the Snake River (RM 62) at about 540 feet elevation (Figure 1). Dryland agriculture and livestock grazing are the dominant land uses in mid-elevation upland areas, while forestry, recreation and grazing are the primary land uses at higher elevations. The subbasin is characterized by deep v-shaped valleys in headwater areas gradually widening into comparatively broad valley bottoms on the lower mainstem of the Tucannon River and Pataha Creek. The topography is the result of folding and faulting of extensive deposits of Columbia River basalts. Highly erodible loess soils on the plateau tops support extensive acreages of dryland farming. There is generally a large difference in elevation between the valley bottom of the drainage network and the surrounding plateaus. Intermittent and/or ephemeral streams are present throughout the watershed. Under typical conditions these streams do not convey much water, but during thunderstorms or rain-on–snow events they are capable of carrying immense debris torrents into the Tucannon River. The sediment-moving capacity of these small streams is easily seen in the extensive alluvial fans deposited at their mouths. Habitat conditions in the Tucannon subbasin range from generally fair to good in the Tucannon drainage to generally poor in the Pataha drainage.

Salmonid bearing streams in the subbasin include Bear Creek, Sheep Creek, Cold Creek, Panjab Creek, Turkey Creek, Meadow Creek, Little Tucannon River, Hixon Creek, Cummings Creek, Tumalum Creek, Pataha Creek, and the mainstem Tucannon River. Summer steelhead/rainbow, spring Chinook, fall Chinook, resident rainbow trout, and bull trout are currently present. Summer steelhead/rainbow are presumed to be present in Kellogg and Smith Hollow Creeks. Coho were historically present, and in recent years, coho salmon have again begun using the lower reaches of the mainstem Tucannon River. It is likely that the coho recently found in the Tucannon watershed are stray individuals from nearby tribal hatchery reintroduction efforts.

The Tucannon River enters the Snake River at RM 62.5 (RK 100.6) in Lake Herbert G. West, delineated by Lower Monumental and Little Goose dams on the downstream and upstream ends, respectively. Lyons Ferry Hatchery occurs a few miles downstream of the Tucannon mouth, at the confluence of the Snake and Palouse rivers. This portion of the Snake River is primarily a migration corridor for anadromous salmonids. Spring

Chinook and summer steelhead use the Snake River to migrate to and from the ocean and/or between tributary streams, while fall Chinook use the Snake River for spawning, rearing and migration. Sockeye salmon migrate through this corridor to and from spawning grounds in Idaho's Salmon River basin.

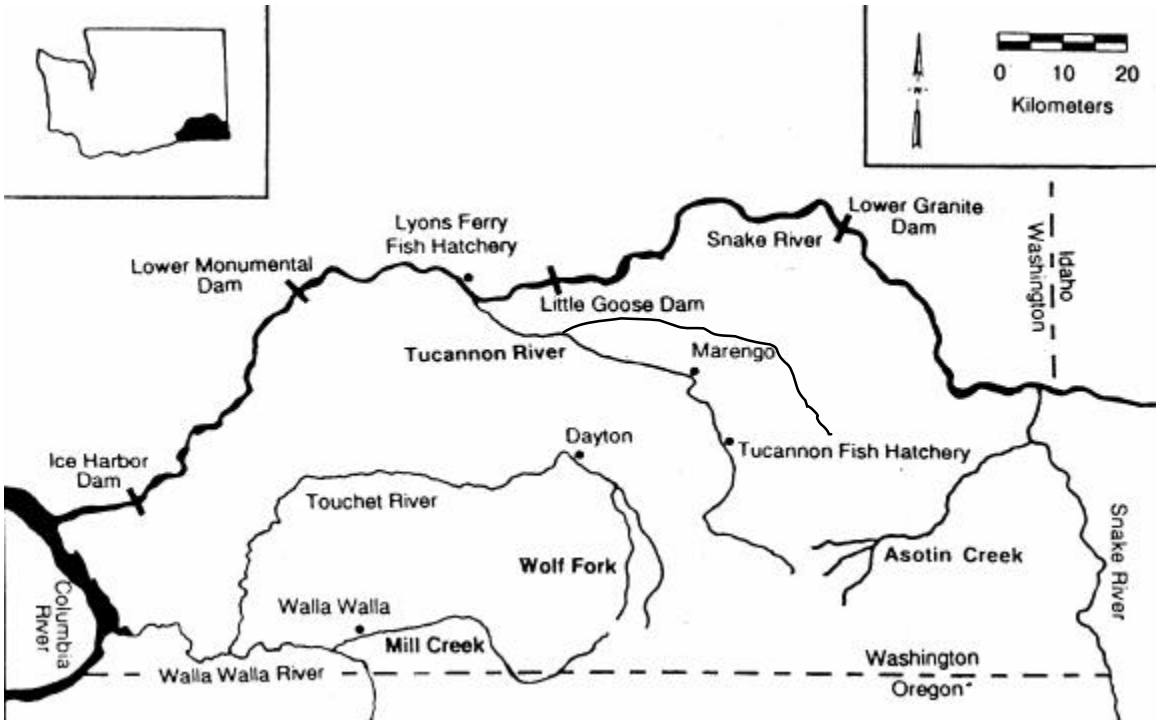

Figure 1. Map of Southeast Washington showing the location of the Tucannon River in relation to the four Lower Snake River dams.

Methods and Materials:

The approach of the study is to use radio-telemetry to monitor the movements of adult bull trout as they move within the Tucannon River subbasin, and as they emigrate to the Snake River to rear throughout the winter. We successfully captured and tagged adult bull trout at the Tucannon Hatchery weir in May and June, and at a temporary downstream migrant trap near the Tucannon Hatchery in September and October. The temporary downstream migrant trap was constructed using a standard picket weir design with a narrowing trap throat entering a holding box (Hubert 1983). The weir used 1" spacing between the pickets and a 4 X 3 X 3 ft. holding box. In addition, angling with lead-head jigs with barbless hooks proved successful for capturing bull trout in September and October. Fish of appropriate size ($\geq$ 50 times transmitter weight in air) were surgically implanted with 241-761 day life expectancy radio-tags. Surgical procedures generally followed those used by Faler et al. (1988), Faler and Bair (1992), Kelly Ringel and DeLaVergne (2000/2001), and Schriever and Schiff (2003).

Radio-tags used during 2003 were obtained from Lotek Engineering and Advanced Telemetry Systems (ATS). We utilized 3 different models/sizes of Lotek 3V micro coded fish transmitters: 1) model MCFT-3BM weighed 7.7g in air, had a 400 day life expectancy with a 12-sec burst rate, and was suitable for fish as small as 385 g; 2) model MCFT-3EM weighed 8.9g in air, had a 399 day life expectancy with a 5 sec burst rate, and was suitable for fish as small as 445 g; and 3) model MCFT-3A weighed 16.0g in air, had a 761 day life expectancy with a 5 sec burst rate, and was suitable for fish as small as 800 g. All Lotek tags operated on RF frequency 149.380 MHz (Lotek Channel 4) and were individually micro-coded for easy separation of individual fish. We also used ATS model F1830 tags that weighed 11 g in air, had a 241 day life expectancy, and a 2 sec burst rate. These tags were not coded, and each tag transmitted on an individual frequency between 151.025 and 151.197 MHz, separated by at least .015 MHz.

Radio-tagged fish locations were monitored at least weekly in the Tucannon River from shore or aircraft. Individual fish locations were recorded by GPS coordinates during flights, and proximity to landmarks and/or road miles while tracking on ground. In addition, selected individual fish were located and observed underwater using drysuits and snorkel gear. We continued use of the three fixed telemetry stations operated during FY02, and on October 30, an additional fixed telemetry station was activated at river mile 10.0, near the adult steelhead weir operated by the WDFW Snake River Laboratory (Figure 2). This station was established to determine if operation of the steelhead weir impeded the downstream migratory movements of bull trout attempting to pass that location. The lowermost station, at river mile 1.6, was operated to identify the timing of movements out of the Tucannon subbasin and into the mainstem Snake River. The two remaining fixed stations at the Tucannon Hatchery weir and Camp Wooten (RM 36.8 and 43.0) were operated to record timing of fish movement into and out of the upper Tucannon River.

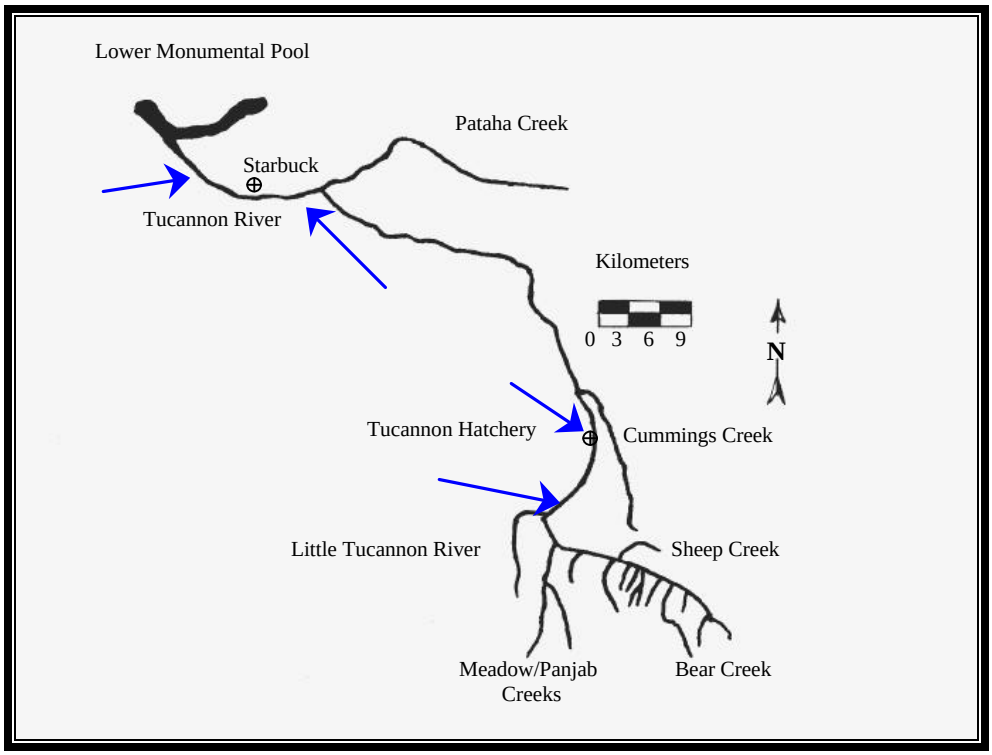

Figure 2. Fixed telemetry data logger stations (indicated by arrows) in the Tucannon subbasin, fall, 2003.

Depth Transmission Tests

On December 11, 2003, we submerged ATS radio-tags at depths of 20 and 30 feet in Lower Granite Pool to test our capability of detection at these depths. We used extra model F1830 transmitters purchased for this project, an ATS R-4000 Receiver, and an "H" antenna. Tests were conducted from a helicopter at 200 and 700 feet above the water surface. Radio-tags were secured with rubber "O" rings and electrical tape on 5/8" braided nylon rope 5-6 feet above 5 lb pyramid lead anchors. Each transmitter was affixed to the rope so it would be positioned with the transmitter's long axis horizontal under rope tension. Each rope was also affixed with a surface buoy marker for easy location and retrieval.

Results and Discussion

This section includes several facets of work, some of which were initiated during the 2002 reporting cycle, but culminates in the 2003 reporting cycle. The data are organized both chronologically and by task for fish tagged in: 1) the spring of 2002, 2) the spring of 2003, and 3) the fall of 2003. Recoveries of radio-tags are also organized in this way. In contrast, all location data for the fish tagged in the spring and fall of 2003 was combined to analyze movements and distribution of 2003 migrants.

Migration and Distribution (fish tagged in 2002)

Four of the fish (9.8% of the 41 radio tagged individuals) tagged in 2002 survived and carried their radio tags through the winter and into spring/summer 2003 (codes 90, 75, 59 and 53). One of these fish spent the winter near the Highway 12 Tucannon River bridge, between RM 11 and 14 (Figure 3). In late May or early June, this fish migrated upstream to the vicinity of Marengo at RM 25, at which time the tag became stationary. This tag was not recovered, but has not moved since June 2003; it is likely that the fish carrying this tag either died or rejected the tag. The other 3 over-wintered in the vicinity of the Tucannon Hatchery between RM 34 and 36 (Figure 4). All three of these fish were visually observed and verified alive in the spring of 2003. In addition, they later migrated to known spawning habitat in the upper Tucannon River, and were distributed between RM 48 and 50 by late summer when the batteries in the tags expired.

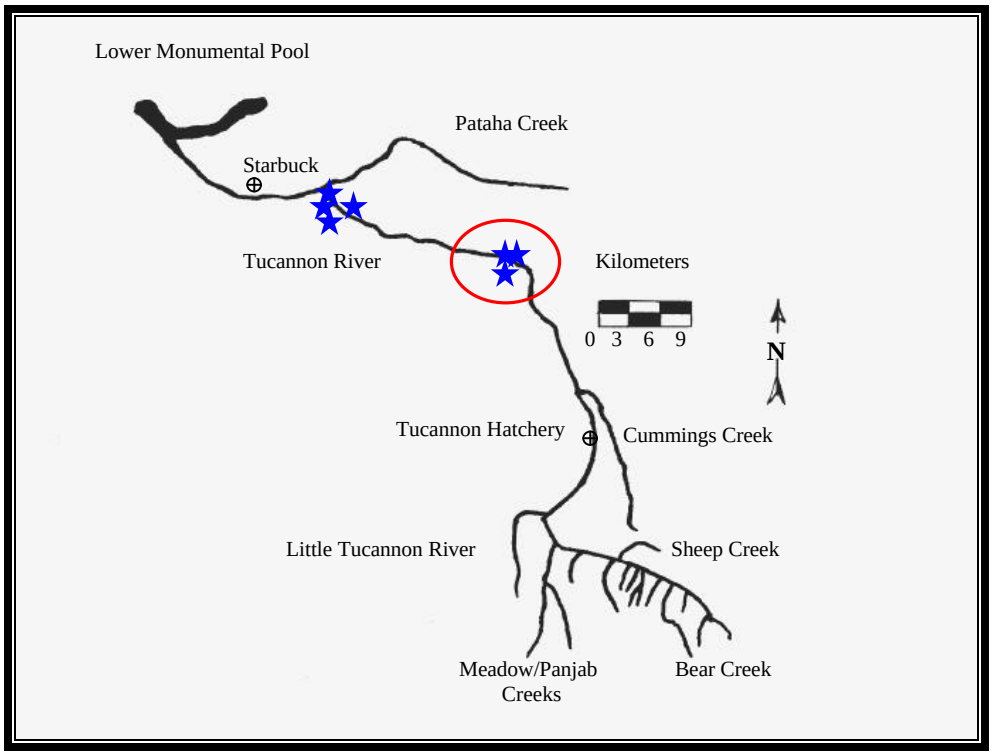

Figure 3. Distribution of a radio-tagged bull trout (code 90) that carried its tag from December 2002 through July 2003 in the Tucannon subbasin. Each star may represent more than one fish location. The oval represents locations in June and July 2003, following an upstream surge in movement.

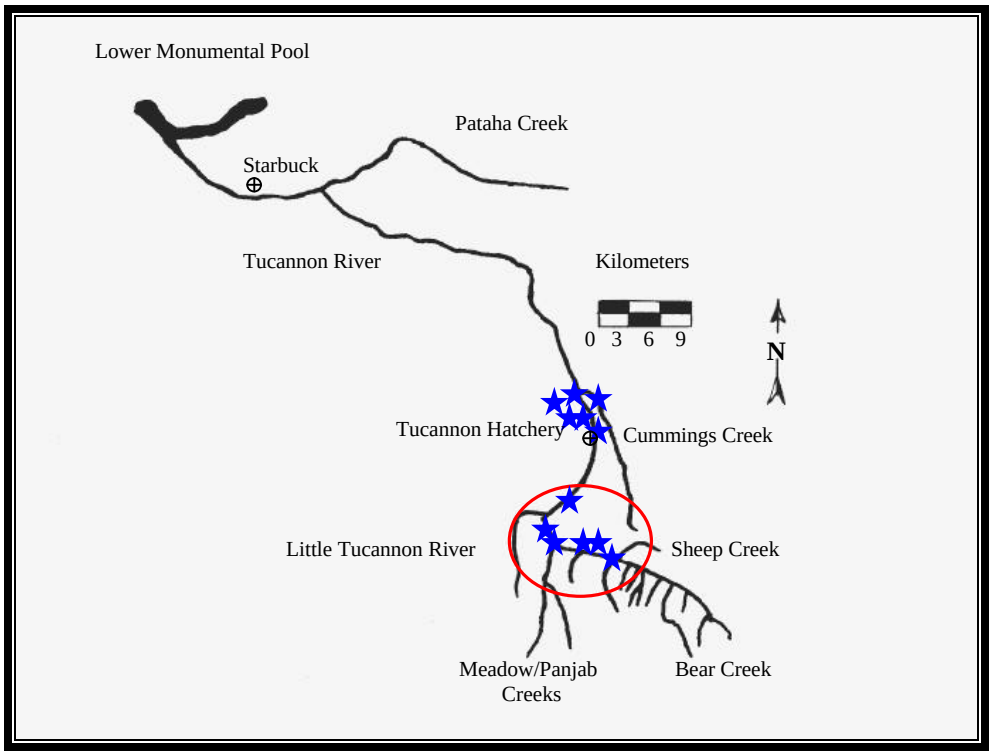

Figure 4. Distribution of a radio-tagged bull trout (code 75) that carried its tag from December 2002 through August 2003 in the Tucannon subbasin. Each star may represent more than one fish location. The oval represents locations in June through August, 2003, following an upstream surge in movement. The distribution and movements associated with this fish were very similar to those observed by codes 59 and 53.

Tag Recovery (fish tagged in 2002)

As of April, 2003, 33 radio tags remained in the field from 2002, and 20 of those were recovered in spring and summer of 2003 (Table 1). Of the remaining 13 tags, at least 4 were carried by live bull trout throughout the winter of 2002/2003 (as described above) and 9 tags remain unrecovered. The status of the 9 unrecovered tags fall into one of three categories: 1) the battery life of the tag expired and we were no longer able to locate the tag to determine if it was still carried by a live fish; 2) the fish rejected the tag prior to, during, or after known spawning season timeframe and survived, and the fish that had been carrying the tag may or may not have successfully spawned; or 3) the fish carrying the tag died prior to, during, or after spawning, and cause of death is unknown. Most of these tags remain in known spawning areas within remote parts of the Wenaha-Tucannon Wilderness, which makes tag recovery extremely difficult, so few attempts to recover the tags have been made. For a few of these tags, recovery attempts have been unsuccessful because at the time of the recovery attempt, the tag was found to be buried deeply under streambed substrate or within in-stream debris jams. We believe that none of the

un-recovered tags from 2002 were carried by live fish through the winter of 2002-2003 primarily because we detected no movement following the spawning season. It is likely that the fish originally carrying these tags died, or rejected their tag. We have documented that it is possible for a radio-tagged bull trout to reject the radio-tag through the body wall and survive (Plate 1). Additionally, natural post-spawn mortality may be a partial explanation for the lack of movement of these tags; evidence for this possibility includes the relatively high percentage of bull trout captured in the temporary downstream migrant trap constructed near the WDFW Tucannon Hatchery which displayed varying degrees of dermal fungal infections (Plate 2).

Table 1. Recovered radio tags from bull trout tagged at the Tucannon Hatchery weir (RM 36.8) in spring 2002.

Code	Implant Date	Date of Recovery	Final location and Comments
52	5/29/02	5/14/03	Tag recovered under debis jam 1.3 mile upstream of Sheep Creek. Tag found lying within a few yards of multiple bull trout redds. No damage to tag.
55	5/30/02	4/29/03	Tag recovered near a Great Blue Heron rookery at river mile 16.4. Fish may have been killed by a predator.
60	5/29/02	6/5/03	Tag recovered near water's edge from within a small debris pile in wilderness area (river mile 53.1). No damage to tag.
61	5/19/02	6/11/03	Tag recovered from stream bottom in a deep, fast run at a point on the Tucannon River near USFS 4712 milepost 3.4. Antenna appeared to have been bitten.
62	5/19/02	5/21/03	Tag recovered at base of hill on opposite bank of river from W. T. Wooten Wildlife Area campground #5. No damage to tag.
63	6/3/02	5/9/03	Tag recovered instream near USFS 4712 milepost 1.3. No damage to tag.
64	5/26/02	6/11/03	Tag recovered from flooded brushy area alongside stream channel near USFS 4712 milepost 3.3. Antenna appeared to have been bitten.
66	5/31/02	5/14/03	Tag recovered 0.5 mile upstream of Sheep Creek lying within a few yards of multiple bull trout redds. No damage to tag.
67	5/28/02	5/20/03	Tag recovered ~500 yards upstream of a point on the Tucannon River adjacent to the junction of USFS 47 and USFS 4620. No damage to tag.
68	5/20/02	6/11/03	Tag recovered under rootwad against bank, in 4 inches of water near USFS 4712 milepost 3.1. Most of antenna had been severed.
70	6/14/02	6/11/03	Tag recovered from within a submerged logjam at river mile 49.6. Tag and antenna appeared to have been bitten.
72	5/17/02	5/29/03	Tag recovered 0.6 mile upstream of Deer Lake. No damage to tag.
73	5/28/02	5/14/03	Tag recovered ~1.4 mile upstream of Sheep Creek. No damage to tag.
76	5/19/02	5/30/03	Tag recovered 0.5 mile upstream of the Beaver-Watson Lakes bridge. No damage to tag.
78	6/13/02	5/23/03	Tag recovered near the mouth of Pataha Creek. No damage to tag.
79	5/28/02	5/14/03	Tag recovered ~1.4 mile upstream of the mouth of Sheep Creek. No damage to tag.
80	6/13/02	5/20/03	Tag recovered downstream of the Cow Camp Cabins (river mile 44.5). No damage to tag.
83	5/29/02	4/29/03	Tag recovered near a Great Blue Heron rookery at river mile 16.4. Fish may have been killed by a predator.

Table 1 (continued).

Code	Implant Date	Date of Recovery	Final location and Comments
89	6/14/02	5/9/03	Tag recovered on the Tucannon River at a point adjacent to USFS 4712 milepost 4.2. No damage to tag.
91	6/13/02	5/9/03	Tag recovered on river bank 0.7 mile upstream of the mouth of Panjab Creek. No damage to tag.

Plate 1. Digital photo of a bull trout collected at the Tucannon Hatchery weir in the spring of 2003 that had expelled its radio-tag (code 74) in the fall of 2002 and survived. Note the Y-shaped scar (indicated by red oval) where the tag was apparently pushed through the body wall. This fish was subsequently implanted with a new radio-tag (code 32), and the tag was recovered in the fall of 2003.

Plate 2. Digital photos of 2 separate bull trout recovered at the temporary downstream migrant trap that illustrate the varying levels of *Saprolegnia* (indicated by red ovals) observed in post spawn fish in the Tucannon River, October, 2003.

Spring Sampling and Tagging (2003)

Two hundred sixty-one bull trout were captured at the Tucannon Hatchery weir in 2003 (Table 2), and we surgically implanted radio transmitters in 20 of them. Fork length (mm) and/or weight (g) was recorded for 256 (98%) and 205 (79%) were scanned for PIT tags. Twenty-four (12%) of these were recaptures, and 181 (88%) were implanted with a new PIT tag.

Table 2. Bull trout trapping data at the Tucannon Hatchery weir, 1998 - 2003.

Year	Number of Bull Trout Captured	Capture Dates
1998	82	4/1 - 8/29
1999	39	5/20 - 7/12
2000	41	4/17 - 8/29
2001	39	5/12 - 6/27
2002*	208	5/17-7/31
2003*	261	3/14 - 7/24

*Gaps between pickets were reduced prior to the 2002 trapping season.

Tag Recovery (fish tagged in spring, 2003)

Ten of the 20 bull trout radio-tagged at the Tucannon Hatchery weir in spring, 2003, were subsequently recovered (Table 3). Five (50%) of these tags were from fish that migrated to known spawning grounds. Circumstances surrounding 1 tag (code 29) suggested evidence of poaching, and another (code 33) was returned by an angler after illegal

harvest of the fish, less than one month after surgery. The remaining 3 were either post-surgical mortalities, or were subjected to predation by piscivorous birds or mammals.

Table 3. Recovered radio tags from bull trout tagged near the Tucannon Fish Hatchery in spring 2003.

Code	Implant Date	Date of Recovery	Final location and Comments
2	5/15/03	10/8/03	Tag recovered from instream debris pile near Ladybug Flat campground (USFS 4712 milepost 2.1). No damage to tag.
18	5/15/03	10/22/03	Tag recovered at river's edge submerged under 3 inches of water near Tucannon Road milepost 10.9. No damage to tag.
21	5/15/03	10/16/03	Tag recovered on Bear Creek ~150 yards downstream of the mouth of the unnamed Bear Creek tributary that has a large falls (Bear Creek stream mile 1.8). No damage to tag or antenna.
32	5/20/03	10/8/03	Tag recovered near Ladybug Flat campground (USFS 4712 milepost 2.1). Tag recovered from within small animal den. Antenna appeared to have been bitten.
8	5/23/03	10/8/03	Tag recovered within 2 yards of water's edge, on a small animal trail through tall riverbank grass and brush near milepost 8.8 on Highway 261. No damage to tag.
33	5/23/03	6/12/03	Fish caught and killed illegally by a poacher near Big Four Lake. (Evidence documented.)
27	5/25/03	8/21/03	Tag recovered near W. T. Wooten Wildlife Area campground #8, in dry side channel. Pieces of bone and cartilage scattered nearby. Antenna appeared to have been bitten.
28	5/25/03	7/9/03	Tag found inside animal den along with feathers and crayfish shells, 20 yards from river, 0.4 mile downstream of Turner Road bridge. Antenna appeared to have been bitten.
29	5/27/03	8/21/03	Tag recovered near Panjab bridge. Antenna had been cut. A poacher may have illegally killed this fish.
25	5/27/03	10/16/03	Tag recovered from Bear Creek streambank in rodent den. Chew marks on antenna insulation. Tag near large bull trout redd.

Fall Sampling and Tagging (2003)

A total of 18 bull trout large enough to radio tag were captured between September 24 and October 22, 2003. These fish were captured and radio-tagged during the fall to increase the possibility that radio-tagged bull trout would retain their radio-tag throughout the winter, and potentially enter the mainstem Snake River. Eight of these were captured in the temporary downstream migrant trap, and all of these post-spawn fish were thin and emaciated with varying degrees of *Saprolegnia* dermal fungal infections (Plate 2). An additional 10 were captured by angling, and these were generally in better physical condition than those captured in the downstream migrant trap.

Fifteen of the bull trout captured in the fall were equipped with new radio-tags, while one of the remaining 3 was a radio-tag recapture (Lotek Code 7) from the spring sampling efforts. The other 2 were in poor physical condition, and were released without

implanting a radio-tag. Ten (55%) of the 18 fish were equipped with new PIT tags, 6 (33%) were PIT-tag recaptures from previous sampling sessions, and 1 was released untagged and unscanned because the battery was dead in the PIT tag detector.

Tag Recovery (fish tagged in fall, 2003)

We recovered 4 radio-tags from fish tagged in the fall. Based on evidence, it is likely that anglers illegally harvested 2 of these fish (Table 4). One transmitter was recovered from a nearly dead fish impinged on the steelhead weir at RM 10.3, and another was recovered on an in-stream gravel bar slightly upstream of the reservoir influence zone.

Table 4. Recovered radio tags from bull trout tagged near the Tucannon Fish Hatchery in fall, 2003.

Code	Implant Date	Date of Recovery	Final location and Comments
3	9/25/03	10/22/03	Tag recovered at river mile 12.6. Both radio and PIT tags found on streamside bedrock shelf, side-by-side, without evidence of fish remains. Area is a popular steelhead fishing section, this bull trout may have been a poaching mortality.
151.182	9/25/03	10/17/03	Tag recovered at WDFW Steelhead weir at RM 10.3. Fish was near-dead, pinned against weir pickets.
12	10/20/03	12/8/03	Tag recovered near Rainbow Lake (river mile 36.4) on lakeshore dike, antenna slightly shortened -- this fish may have been a poaching mortality.
19	10/20/03	11/24/03	Tag recovered on submerged, mid-stream gravel bar ~100 yards upstream of smolt trap (river mile 1.6) near a large fall chinook redd. No damage to tag, antenna was slightly shortened.

Migration and Distribution (Fish Tagged in 2003)

During the months of June and July radio-tagged bull trout generally moved upstream, and distributed themselves between the Tucannon Hatchery and Sheep Creek (Figure 5). Post-tagging recovery may have slowed or delayed migration during this period.
One fish (code 28) moved downstream shortly after tagging, and the tag was recovered inside an animal den on July 9 at river mile 24.4 (Table 3). Another fish (code 8) moved downstream near Starbuck and became stationary in late summer. This tag was recovered at RM 3.5 on October 8 a few yards from water's edge on a small animal trail. These fish may have died due to complications arising from surgery.

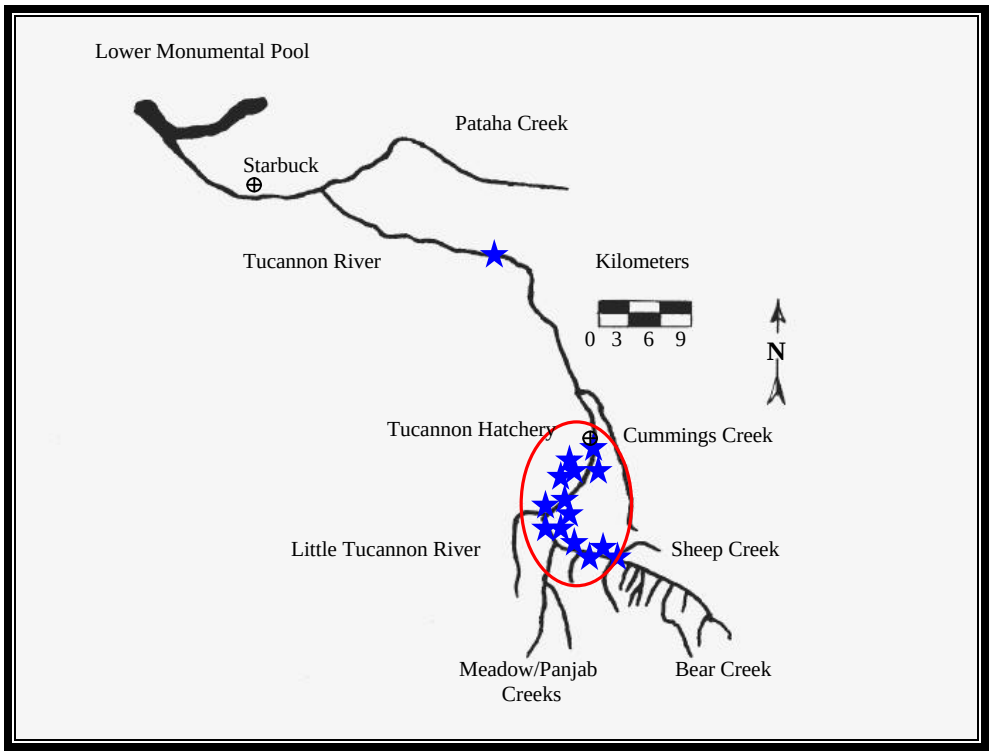

Figure 5. Distribution of radio-tagged bull trout in the Tucannon subbasin in June and July, 2003. Each star may represent more than one fish location. The oval represents a high concentration of fish locations.

Later in the summer and into September, bull trout moved into known spawning areas in Bear Creek and the upper mainstem Tucannon River (Figure 6). No radio-tagged fish were observed moving into the Panjab or Meadow creek spawning areas in 2003

Post spawning movements in October exhibited a general downstream migration (Figure 7), and were similar to those observed in the Tucannon River by Faler et al. (2003) and Underwood et al. (1995), and typical of post-spawning movements observed in other migratory populations (Elle 1995; Faler and Bair 1992; Kelly Ringel and DeLaVergne 2000/2001, Schriever and Schiff 2003, Theisfeld et al. 1996).

By mid November, radio-tagged bull trout were distributed from RM 56 near the headwaters of the Tucannon River down to RM 6.4, just a few miles upstream of the reservoir influence zone (Figure 8). No appreciable change in distribution was noted through the end of December. One tag was detected by helicopter at about RM 2.0, but then was recovered at RM 1.9 on November 24 on a mid-stream gravel bar (Table 3). Because the disposition of this fish was unknown when the tag became stationary, it is unclear if this fish actively migrated to this area before the tag was deposited on the gravel bar.

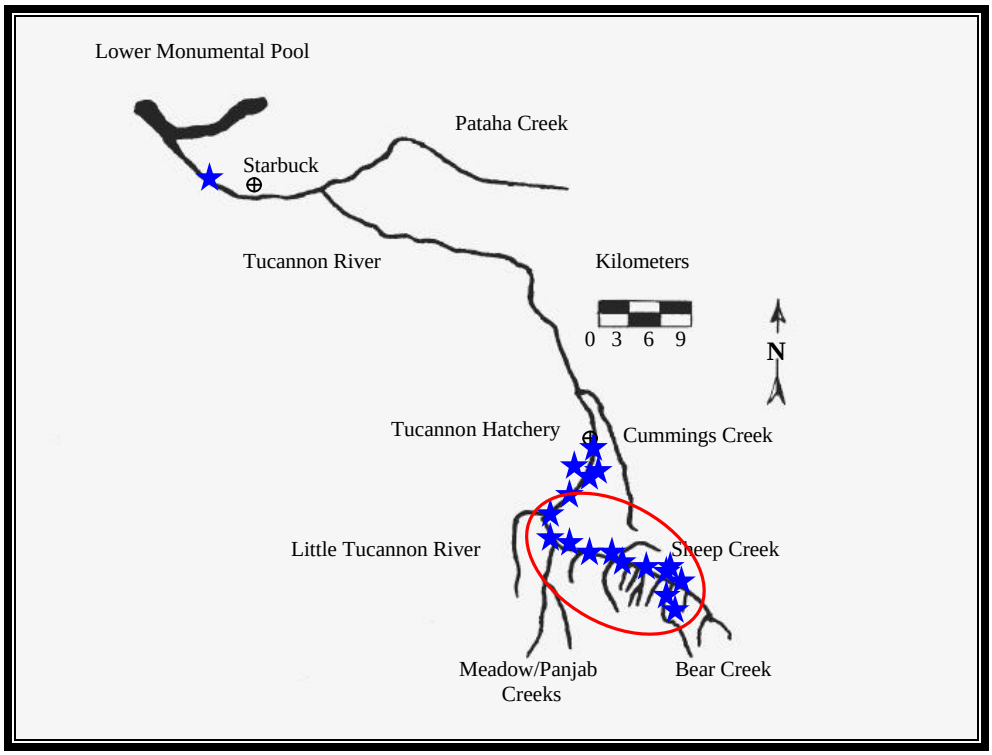

Figure 6. Distribution of radio-tagged bull trout in the Tucannon subbasin in August and September, 2003. Each star may represent more than one fish location. The oval represents a high concentration of fish locations.

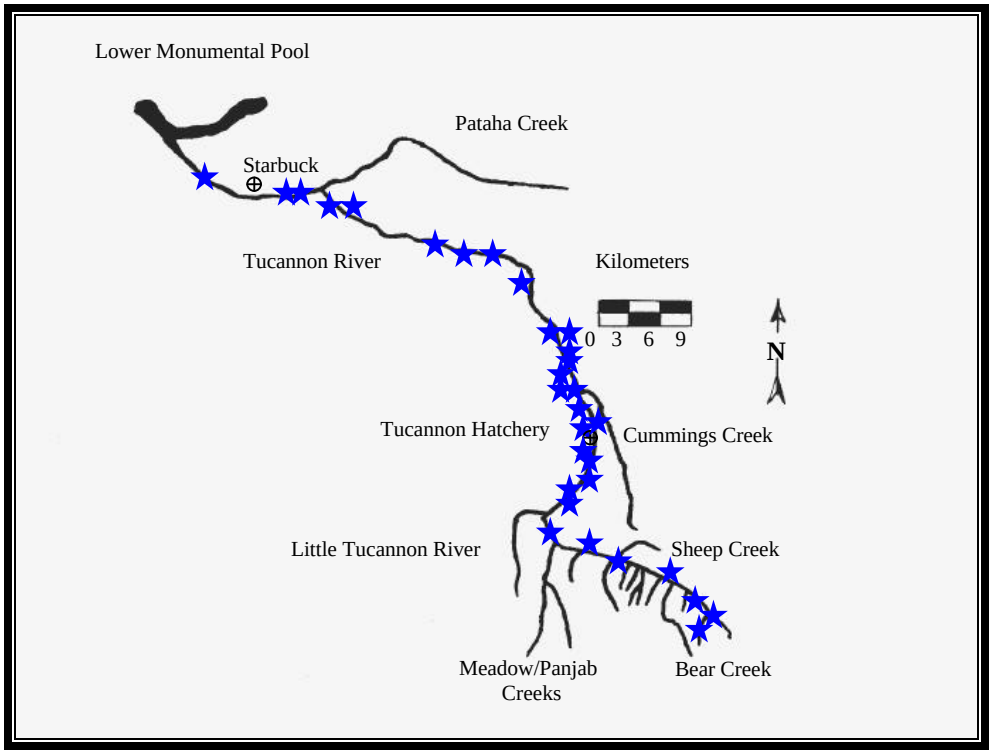

Figure 7. Distribution of radio-tagged bull trout in the Tucannon subbasin in October, 2003. Each star may represent more than one fish location.

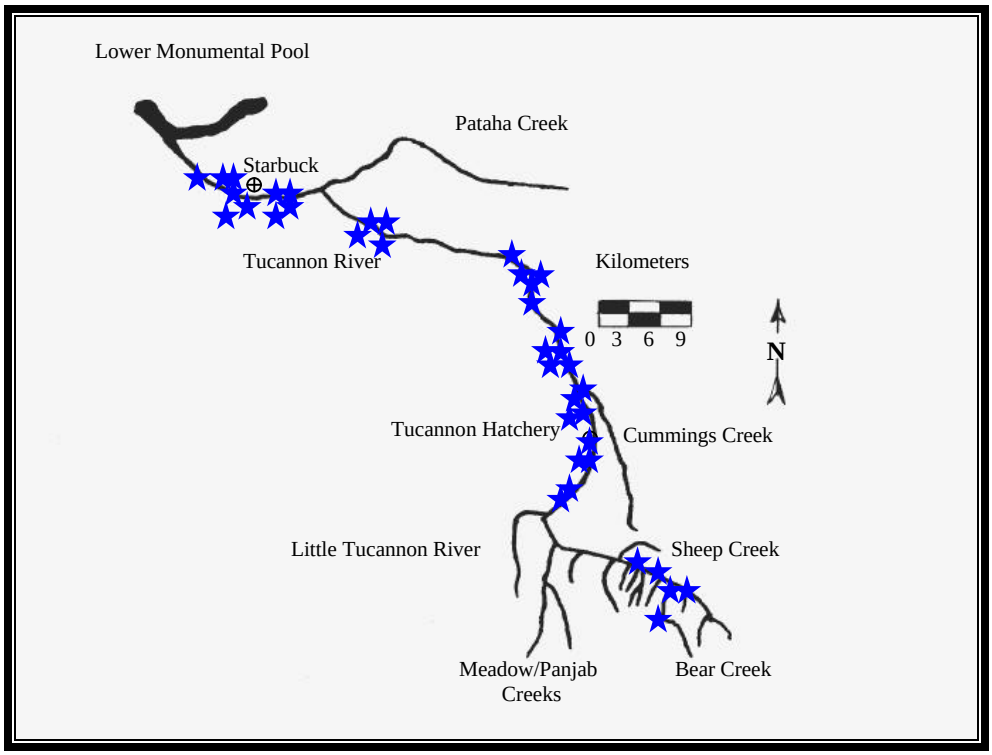

Figure 8. Distribution of radio-tagged bull trout in the Tucannon subbasin in November and December, 2003. Each star may represent more than one fish location.

The WDFW steelhead weir and trap at RM 10.3 had the potential to impede the downstream migration of bull trout, and one of our fall radio-tagged fish (ATS, 151.182) was found barely alive impinged on the pickets less than a month after tagging (Table 3). The surgical incision of this fish was highly infected with surrounding necrotic tissue, and we believe it was close to death before it was impinged on the weir. On October 30, we established a new fixed data logger at the site, but no radio-tagged bull trout appeared to be delayed as a result of the weir. The weir was operated to trap returning adult steelhead on weekdays from October through December. On weekends, a section of the picket weir was removed to allow free passage. Three separate radio-tagged bull trout passed through the weir on October 21, and November 4 and 14. It may be important to note that the first 2 fish passed on week days when the trap was set and in operation. This suggests that there was either a hole in the trap that allowed free passage, or the picket spacing was large enough for bull trout to pass through. We incorporated a downstream migrant trap box into the weir from December 10 through 31, 2003, but no bull trout were captured.

Snorkeling efforts to confirm the status of radio tagged fish showed that there were at least 7 radio-tagged bull trout in good health as of November, 2003 (Table 5). One of these fish (ATS, 151.086) was incidentally caught twice by the same recreational angler while fishing for steelhead. According to the angler's report, a radio-tagged bull trout was captured and released from the same pool, in two consecutive months; the fish was visually estimated to be of the same size and length. On both occasions, the captured and

released bull trout appeared to be healthy. Other radio-tagged bull trout were observed in August and September on the spawning grounds while conducting redd surveys. Two of these, codes 18 and 25, were observed in Bear Creek in August and September, and appeared to be healthy. However, the radio-tags they had been carrying were recovered during October in downstream areas (Table 2), suggesting post spawning mortality, which may or may not have been influenced by the radio-tag they had been carrying.

Table 5. Confirmed observations of healthy radio-tagged bull trout in the Tucannon subbasin, June through December, 2003.

Code	Date	Observation Details	Location (RM)
151.044	12/10/03	Fish observed while snorkeling -- small area of irritated flesh surrounding tag incision; tag may be bulging against skin.	35.2
151.086	11/22/03	Tucannon Road milepost 4.3 -- fish caught and released by recreational angler -- fish appeared healthy.	17.9
151.086	12/01/03	Tucannon Road milepost 4.3 -- fish caught and released by recreational angler -- fish appeared healthy.	17.9
4	12/04/03	Fish observed with polarized glasses, antenna visible, swimming normally.	6.4
7	08/27/03	Fish observed while snorkeling, ~0.4 mile downstream of Bear CK mouth. Fish active, appeared healthy.	53.8
7	09/16/03	Fish observed while snorkeling. Tag intact, fish appeared healthy. Located ~0.6 mile upstream of Cow Camp bridge.	45.2
9	10/10/03	Fish observed with polarized glasses near the WDFW Tucannon Hatchery bridge. Fish active and appeared healthy.	36.0
10	09/09/03	Fish observed by spawning surveyor while conducting a bull trout spawning survey on Bear Creek. Fish alive and appeared healthy.	~0.7
11	12/04/03	Fish observed alive while snorkeling, appeared healthy, with antenna intact.	31.6
13	12/04/03	Fish observed while snorkeling. Fish active, appeared healthy.	32.0
14	12/08/03	Fish observed near Rainbow Lake while snorkeling. Appeared to be loose skin on tissue surrounding tag incision and antenna exit site. Fish exhibited normal behavior.	36.4
17	12/08/03	Fish observed with polarized glasses. Antenna visible, fish swimming normally ~300 yards downstream of WDFW Tucannon Hatchery outflow.	36.0
18	08/27/03	Fish observed while snorkeling, ~0.4 mile downstream of the mouth of Bear Creek. Fish active and appeared healthy.	53.8
24	06/11/03	Fish observed while snorkeling. Fish alive and swimming normally.	49.2
25	09/09/03	Fish observed by spawning surveyor while conducting a bull trout spawning survey on Bear Creek. Fish alive and appeared healthy.	~2.6
26	09/16/03	Tag seemed to move within pool; snorkeler unable to approach fish closely enough for observation. Fish located ~0.2 mile upstream of Cow Camp bridge.	44.8
26	10/10/03	Fish observed with polarized glasses near the WDFW Tucannon Hatchery bridge. Fish active and appeared healthy.	36.0

Depth Transmission Tests

We were able to successfully detect the ATS F1830 transmitters submerged at 20 and 30 feet in Lower Granite Pool. In addition, we were able to audibly detect the tags from a greater linear distance from 700 feet above the water surface than 200 feet above the water surface. Because these tags transmitted on separate frequencies, and were not coded, identification of each individual tag was possible. These results are similar to the results obtained from transmission tests of submerged Lotek radio-tags conducted 2002; however, maximum depth transmission was slightly poorer for Lotek radio-tags than for ATS radio-tags (30 vs. 25 ft., respectively). Additionally, identification of individual Lotek radio tags (logged on the receiver) was not possible at any depth tested even though the tag could be heard on the receiver. For that purpose, ATS tags had an advantage, as each individual ATS tag transmits on a separate frequency.

Summary and Conclusions

Movements and Distribution

Bull trout generally moved upstream rapidly after recovering from tagging. By late June or early July most radio tagged bull trout had moved upstream into the Wenaha-Tucannon Wilderness, where recreational angling is prohibited and water temperatures typically remain below 50-55 ^{o} F. In September, bull trout were located in known spawning areas including the Tucannon River upstream of Bear Creek, within Bear Creek, and in the Tucannon River between Panjab and Bear creeks. No radio-tagged fish moved into the Panjab Creek drainage in 2003.

Some bull trout initiated downstream movement from the spawning areas in September, and by mid November bull trout movements ceased. By this time bull trout radio-tags were distributed from the upper reaches of the Tucannon River subbasin within the Wenaha-Tucannon Wilderness Area downstream to within a few miles upstream of the reservoir influence zone. We suspect that radio-tags which remained within the Wenaha-Tucannon Wilderness Area into November are no longer carried by live bull trout, primarily based on tag recovery results obtained in the spring and summer of 2003 (Table 1).

A Lotek fixed-site receiver near the mouth of the Tucannon River operated intermittently from December 1, 2002 through May 31, 2003, and September 18 through December 31, 2003. During the short periods of downtime due to poor battery performance, we maintained contact with all bull trout tagged with Lotek transmitters. No radio tagged fish were detected at this site, or downstream of this site during mobile tracking. As a result, we are confident that no fish tagged with Lotek transmitters entered the Snake River during this reporting period. However, one fish tagged with an ATS transmitter (151.164) disappeared shortly after we located the fish at RM 10. This fish had passed through the WDFW steelhead weir on October 21. Because this fish was tagged with an ATS radio-tag, it could not be detected by the Lotek fixed telemetry receiver located near

the reservoir influence zone (RM 1.6). This particular fish was the largest bull trout tagged in 2003, and at tagging, was 565 mm fork length and weighed 2,150 g. Although the fate of this fish was discovered outside of this reporting period, we feel compelled to include it in this report because of the significance to this project. On February 19, 2004, ATS radio-tag 151.164 was detected during a helicopter flight at RM 0.7 in Alkali Flat Creek, which enters the Snake River from the north about 5 miles upstream of its confluence with the Tucannon River. Later that day, the tag was recovered from the top of a boulder laying in an undercut bank at the waters edge. Because it appears highly unlikely that this fish could have drifted 5 miles upstream in the Snake River, or that a piscivorous bird would have carried a fish of this size that far, we believe this fish swam into Alkali Flat Creek, and the fish subsequently died or rejected its radio tag. If our assumptions are correct, this would be the first documented occurrence of a radio-tagged bull trout from the Tucannon River utilizing the mainstem Snake River for over-wintering habitat.

A basic assumption of radio tagging bull trout to monitor their movements is that the implanted transmitters and the tagging process does not affect their movements or behavior and that these tagged fish represent the movements of untagged fish. We have documented high rates of tag loss during the two years of this study. Most of the tag loss appears to occur during, or shortly after, spawning. Many of the radio tags never move from the spawning grounds. We are uncertain whether the observed high rates of tag loss on the spawning grounds indicates high rates of natural mortality associated with spawning, or whether our observations from radio tagged fish are representative of mortality rates for untagged bull trout. That uncertainty concerns us because it affects our confidence that radio telemetry enables us to accurately document and interpret the spawning and post spawning movements of bull trout. More importantly, few of the radio tags have remained in post spawning bull trout to provide information regarding our primary objectives to document fall and winter movements by bull trout and their migration into of the Snake River. Therefore, we are preparing to change the size of radio tags that we use, and when and where we collect bull trout for tagging. These changes are a new approach to try to maximize the number of radio tagged bull trout available post spawning to adequately document fall and winter movements and any use of the Snake River by bull trout from the Tucannon River. When we consider the high rate of post-spawn tag loss that this project has observed with large, older adults, modifying the approach to focus on out-migrating sub adults and small adults in the lower reaches of the Tucannon River seems a reasonable means of increasing the possibility that radio-tagged fish will retain their tags throughout the winter, and potentially migrate into the mainstem Snake River.

Because we were unable to monitor any movements of the bull trout tagged with ATS tag (code151.164) within the mainstem Snake River, there was again no work completed in association with objectives 2, 3, or 4 of this study. In spite of the obvious tag loss and mortalities associated with our radio-tagged bull trout, we continue to collect empirical data and incidental observations that reinforce the idea that a portion of the Tucannon River bull trout population utilizes the Snake River for over-wintering habitat. During the winter of 2003/2004, the incidental catch of both tagged and untagged bull trout was

reported by steelhead anglers from RM 24 down to and including the reservoir influence zone. In addition, 17 sub-adult or small adult bull trout (range 207 – 325mm, mean =264mm) were captured in the smolt trap operated by the WDFW Snake River Laboratory (RM 1.6) in the fall and winter months. The existence of these sub-adults and small adults in the lowermost reaches of the watershed provides an opportunity to shift the focus of this project to a younger age-class, rather than tagging larger, older fish captured in the spring as they move towards the spawning grounds. It would seem reasonable to assume that those fish captured at RM 1.6 were destined to over-winter in or very close to the mainstem Snake River.

We documented evidence that bull trout can reject their radio-tag, and survive. This is similar to the evidence documented by WDFW in 2001 on the Burnt Fork of the Touchet River subbasin (Mendel et. al 2003). We theorize that the radio tag is expelled through the body wall. On May 17, 2002, an individual bull trout was captured at the WDFW Tucannon Hatchery weir, PIT-tagged, and surgically implanted with a Lotek radio-tag (code 74). This fish migrated steadily upstream after radio-tagging, and on September 13 of the same year the radio tag was located at river mile 55.1 on the mainstem Tucannon River. This tag did not move after that date. The tag was not recovered, and the status of the fish was unknown. On May 20, 2003, the same fish was recaptured at the WDFW Tucannon Hatchery weir. We know that this was the same individual because the fish had retained the PIT-tag (3D9.1BF0EDB1EF) originally implanted in 2002. Posterior to the surgical scar caused by implanting the radio tag in 2002, there was now an additional scar, larger in size, which we theorize was a result of expelling the radio-tag through the body wall (Plate 1). This fish was implanted with a second Lotek radio-tag (code 32), and the fish exhibited similar migratory movements in 2003. Radio-tag code 32 was subsequently recovered from within a streamside small animal den at river mile 48.2 near a USFS campground. This fish may have died before or after spawning in 2003, and the cause of death is unknown.

Depth Transmission Tests

Based on our test results, we may temporarily lose contact with bull trout tagged with ATS transmitters that migrate to the Snake River if they utilize water depths greater than 30 feet. We also may temporarily lose contact with bull trout tagged with Lotek transmitters that migrate to the Snake River if they utilize water depths greater than 25 feet. However, it is unlikely that fish tagged with Lotek transmitters could avoid detection if they pass the fixed telemetry receiver stations located at RM 1.6 on the Tucannon River, at Lower Monumental dam, or at Little Goose dam. This is not true for ATS tagged fish. There are no fixed sites established to monitor ATS tags, and these fish could potentially go undetected should they migrate to the mainstem Snake River. We intend to focus the remainder of our efforts with Lotek equipment, and accept the fact that due to the limitations of Lotek equipment, we may temporarily lose contact with those fish if they migrate to the mainstem and utilize water depths greater than 25 feet.

Activities Planned for 2004

WDFW will continue to snorkel to verify whether radio-tags are in by live bull trout.

WDFW will continue to integrate all radio tracking information into a single tracking summary for each fish to improve interpretation and understanding of fish movements.

We will no longer use the large, model MCFT-3A radio transmitters from Lotek. The MCFT-3A transmitters require fish 800 g or larger, and based on our observed size classes of pre-spawn adults, these would be the largest and oldest fish in the population. We would expect these larger individuals to exhibit the highest post spawn mortality rate within the spawning population. Because of this, our efforts in spring 2004 will focus on the younger cohorts of returning adults in hopes of increasing the number of radio tagged fish retaining their tags through the winter. We will target 10-20 small to medium size bull trout for radio-tagging in the spring.

WDFW and USFWS will work closely with staff from the Snake River Lab to modify the existing steelhead weir at RM 10.3 to capture downstream migrant bull trout in the fall of 2004. In addition, downstream migrant sub-adult or small adult bull trout captured in the screw trap operated by the Snake River Lab (RM 1.8) will be interrogated for PIT tags, PIT tagged if not already carrying one, and surgically implanted with a radio tag if of appropriate size. We will also increase angling efforts in the fall to collect and radio tag bull trout in the lower Tucannon River.

We intend to test the performance and detection of model NTC6-2 nano-tags from Lotek engineering, and verify that they will be suitable for use with our existing fixed stations, expected depth transmission, and mobile tracking scenarios. The nano-tags weigh 4.5 grams in air, and have a life expectancy of 294 days at a 6 sec burst rate. We will be able to radio tag bull trout as small as 225 grams with the model NTC6-2 tags. If they prove suitable, we will focus on the capture and tagging of 20-30 out-migrating sub-adult or small adult bull trout in the fall of 2004, thereby further increasing the chances of monitoring radio-tagged fish in the Federal Hydropower System during the winter.

Summary of Expenditures

- Acquisition of one (1) R-4000 radio receiver from ATS ($2,260).
- 18.75 hours of helicopter time, Jan-May, Sept-Dec ($12,867)
- Radio tags (40) from Lotek Engineering ($8,565).
- Helicopter Helmets (2) Gentex SPH-5 ($1,117).
- Dry Suits and Storage bags from O.S. Systems ($1,792)

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